

**SECTION 051800**  
**DUCTWORK FABRICATION**

**PART 1 – GENERAL**

101. EXTENT
- 101.1 Furnishing and fabrication of ductwork shall conform to the requirements as specified herein.
- 101.2 The Work shall include detailing, furnishing, fabricating, delivering to the project site the following unless otherwise noted:
- a. Stiffeners, internal bracing and trusses.
  - b. Flow control devices, turning vanes and splitter plates.
  - c. Access doors and gasket sealing material.
  - d. Condensate Collection Devices
  - e. Expansion joints.
  - f. Sliding bearing plate assemblies, sole plates, guide bars, hold down bars and leveling shims at all duct supports.
  - g. Instrument and test probe ports, connections and supports.
  - h. Safety handrail and supports located on the inside of the ductwork.
  - i. Shop cleaning, prime and finish coating of external carbon steel surfaces not covered by insulation and lagging.
  - j. Temporary supports, braces, hangers, etc., as required for protection of ducts during shipment.
  - k. Design, furnish and install lifting lugs for handling ductwork during fabrication, shipping and unloading at the site.
  - l. Preparation of shop detail and field erection drawings.
  - m. All other work as specified herein or as required to properly complete the Work.
- 101.3 Work by Others:
- a. Where the CONTRACTOR's work connects to ductwork supplied by others, the CONTRACTOR shall incorporate appropriate measures into the detailing and fabrication of CONTRACTOR's work to accommodate reasonable variations in the actual location of the ductwork supplied by Others. Such measures shall be clearly indicated on the CONTRACTOR's erection drawings. The CONTRACTOR's erection drawings shall clearly indicate any potential field work required by the erection CONTRACTOR as necessary for fit-up.



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Specification G-5301  
Issue: Client Comments, Rev. 3  
September 8, 2011  
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## 102. REFERENCE DOCUMENTS

102.1 Related standard specifications are referenced in this Section. References to these documents shall be to the issue date as adopted in IBC 2006. If the document is not referenced in IBC 2006, then the reference is to the latest issue date of these documents, in addition to Federal, State or local codes having jurisdiction.

102.2 AISC - American Institute of Steel Construction:

- a. 303 - Code of Standard Practice for Steel Buildings and Bridges.
- b. 316 - Manual of Steel Construction, 13<sup>th</sup> Edition.
- c. 326 - Detailing for Steel Construction.
- d. 360 - Specification for Structural Steel Buildings.

102.3 FRP Ductwork

- a. ASME RTP-1, Reinforced Thermoset Plastic Corrosion Resistant Equipment
- b. ASME B&PV Section X, Fiber-Reinforced Plastic Pressure Vessels

102.4 AWS - American Welding Society:

- a. A2.4 - Standard Symbols for Welding, Brazing and Nondestructive Examination.
- b. A3.0 - Standard Welding Terms and Definitions.
- c. A5.1 to A5.29 - Specification for Welding Electrodes.
- d. A6.1 - Recommended Safe Practice for Gas-Shielded Arc-Welding.
- e. D1.1 - Structural Welding Code - Steel.

102.5 ASME - American Society of Mechanical Engineers:

- a. Section V - Nondestructive Examination.

## 103. SUBMITTALS

103.1 Submit the following documents, in accordance with Section I – Contract Drawing and Data Requirements, to the DISTRICT for review:

- a. Shop detail and erection drawings.
- b. Setting diagrams for sliding bearing plates indicating orientation of plate, size, allowable dimensions, guide bars, etc.
- c. Quality Control and Quality Assurance documents listed in Article 104 of this section.
- d. Schedule of Work: Preliminary with bid and a working schedule monthly starting two weeks after award. Schedule shall show graphically the starting and completion dates for the various phases or divisions of the work broken down by ductwork segment or SCR casing. This schedule shall include, but shall not be limited to:

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- d1. Mill order of material and procurement of items such as slide bearing plates and access doors.
- d2. Submittal of shop drawings.
- d3. Shop fabrication.
- d4. Shipping including estimated ship tonnage.
- e. Extent of shop fabrication drawings shall be submitted preliminary with bid and final 4 weeks after award showing field splice locations, size and weight of pieces being shipped.
- f. AISC Certification for steel ductwork: Submit documentation of fabricator's AISC Certification.

104. QUALITY ASSURANCE

- 104.1 Fabricate steel ductwork in accordance with AISC Code of Standard Practice for Steel Buildings and Bridges. Fabrication of steel ductwork shall only be permitted by AISC certified fabricators.
- 104.2 Fabrication, dimensional tolerances, inspection and testing of FRP ductwork shall be in accordance with ASME RTP-1 or ASME B&PV Section X and other applicable USA industry standards.
- 104.3 CONTRACTOR may elect to specify more restrictive requirements. If dimensional tolerances, inspection and testing requirements are not specified in the above standards, CONTRACTOR shall determine same. Dimensional tolerances, inspection and testing requirements shall be specified in CONTRACTOR's shop and field QA/QC procedures and submitted to the DISTRICT and the DISTRICT's engineer for review prior to the start of fabrication.
- 104.4 Quality Control:
  - a. Manufacturer's material certifications, mill test reports or certified material test reports of tests made by an independent testing agency shall be submitted in accordance with Article 103 of this section. Submit documentation prior to fabrication certifying that the products meet or exceed specified requirements of applicable codes and standards. Documentation shall indicate structural strength and destructive and nondestructive test analysis.
  - b. All inspections and tests required by this specification or by the documents referenced in Article 102 of this section are the responsibility of CONTRACTOR. The CONTRACTOR shall maintain inspection and test records on file. The CONTRACTOR shall submit records to the DISTRICT upon request.
  - c. Material and fabrication procedures may be subject to inspection and tests by the DISTRICT in the fabrication shop or on site. Such inspections and tests will not relieve CONTRACTOR of responsibility for providing material and fabrication procedures in compliance with specified requirements.
  - d. Provide access for the DISTRICT's testing personnel to places where components are being fabricated or erected so that required inspection and testing can be accomplished.
  - e. Even though the DISTRICT's testing agency may inspect the Work at the fabrication shop before shipment, the DISTRICT reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.
  - f. Correct deficiencies in fabrication and erection where inspections and test reports have indicated noncompliance with these specifications and requirements. Perform additional tests, at

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CONTRACTOR's expense, as may be necessary to reconfirm any noncompliance of the original Work, and as may be necessary to show compliance of corrected work.

- g. Fabrication errors of steel ductwork shall be rectified as specified in the AISC Code of Standard Practice. Promptly remove and replace materials or fabricated components that do not comply.
- h. Errors in shop fabrication that prevent proper field assembly and fit up shall be reported, as soon as they are discovered, to the DISTRICT. The CONTRACTOR shall then provide to the DISTRICT a course of corrective action such as an immediate substitution of the nonconforming component or arrangement for a field correction to resolve the discrepancy. Based on the DISTRICT's approval of the corrective action plan, the CONTRACTOR shall proceed with installation. Whether the correction is made by substitution or field correction, it shall be performed at no cost to the DISTRICT.

104.5 Welding:

- a. Quality assurance requirements for welding are specified in Section 050525.
- b. Complete penetration groove welds on platework shall be examined in accordance with the requirements of Section 050525.
- c. All welds (field or shop) shall be 100% visually examined in accordance with the Inspection Section of AWS D1.1 or the ASME Construction Code, as applicable.
- d. In addition to visual examination, all duct work gas tight welds (seal welds) shall be examined 100% using the liquid penetrant inspection method per ASTM E165 and Section 6 of AWS D1.1 or in accordance with the requirements of ASME Section V, Article 10 using the vacuum box inspection method.

104.6 Bolting:

- a. Quality assurance requirements for bolting are specified in Section 050523.

105. HANDLING AND STORAGE

105.1 Handling: All materials shall be handled with due care at CONTRACTOR's (or his subcontractors, if any) shop(s) in order to avoid damage to, or deterioration of, the materials before, during and after fabrication, and during delivery. Special care shall be exercised to properly protect shop painted surfaces.

105.2 Storage: During storage of materials at Fabricator's (or his subcontractors, if any) shop(s), due care shall be exercised to store materials off the ground (and temporarily covered, if required) in order to avoid damage to, or deterioration of, the materials from foreign elements and from water, mud, snow, ice or other deleterious materials.

**PART 2 - PRODUCTS**

201. DUCTWORK

- a. The inlet ductwork, outlet ductwork and outlet transition ductwork materials shall conform to the requirements of Section 441130, Wet Flue Gas Desulfurization System.

202. SLIDING BEARING PLATES



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- a. Slide bearing assemblies shall have a maximum coefficient of friction of 0.05 per manufacturer's published literature. The materials used at the sliding surfaces shall be a polytetrafluoroethylene (PTFE) impregnated fabric bearing on a polished stainless steel surface conforming to ASTM A240.
- b. CONTRACTOR shall submit the slide bearing assembly manufacturer's catalog information.

203. ACCESS DOORS

- 203.1 Access doors shall be designed for continuous service and excursion temperatures and pressures as specified in Section 441130.
- 203.2 All personal access doors in the ductwork shall be 24 inches wide by 48 inches high.
- 203.3 Doors shall be detailed and fabricated for tightness and easy operation. Doors shall include a quick-opening inner insulated hinged sealing door and an easily removable outer panel that is durable, lightweight, insulated and weather resistant. Sealing surfaces shall be accurately machined and provided with permanent heat resistant gaskets retained in a groove so that the gaskets will not be damaged or become loose when the door is opened and closed.
- 203.4 All bolts, screws, hinge pins, etc. shall be stainless steel or other appropriate corrosion resistant material and shall be suitable for repeated opening and closing without need for replacement.
- 203.5 Doors shall be furnished with permanent nameplates and OSHA Warning Signs on the exterior surfaces.
- 203.6 Access doors with frames and hardware shall be pre-assembled and shipped loose for welded field installation.
- 203.7 The following list of manufacturers of access doors is provided for the CONTRACTOR's reference:
  - a. Boiler Tube Company of America (IMTEC Flexiseal), Lyman, SC 29365
  - b. Power & Industrial Services Corp., Donora, PA 15033

204. EXPANSION JOINTS

- 204.1 Design and Configuration Requirements:
  - a. Expansion joints shall be designed with vapor and gas barriers to prevent air or flue gas leakage across the joint.
  - b. The expansion joint assembly shall be capable of accommodating the thermal and non-thermal movements between adjacent sections of ductwork. The assembly shall be designed to allow access and replacement from the nearest platform. Fabricate assembly so that the retainer straps and fasteners area not exposed to the flue gas.
  - c. Expansion joints shall have a flanged geometry.
  - d. Belts shall be continuous with no joints or splices at bends, integral molded flanges, attachment holes drilled or punched at the factory and splices all factory made.
  - e. Expansion joints shall have bolts accessible from the outside of the liner.



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- f. Expansion joints shall be capable of being attached to the liner whose inside dimension can vary up to  $\pm 1/4$  inch from normal, without requiring field adjustment.
  - g. Expansion joint flanges shall be provided with mounting holes for supporting and sealing the belts spaced at a maximum spacing of 6 inches.
  - h. Expansion joints shall be designed so that the mounting hardware and backup bars are not exposed to the flue gas.
  - i. Expansion joints shall be capable of being changed from outside the ductwork.
  - j. The flange design stress levels shall be in accordance with the AISC Structural Steel Manual or FRP manufacturer's recommendations.
  - k. Expansion joints shall be designed such that flange bolt heads enter from expansion joint side of the flange.
  - l. CONTRACTOR shall indicate if internal baffles are required.
  - m. The expansion joint design shall be such that no edges of joint belt are exposed to flue gas.
  - n. Expansion joint flanges and backing bars shall have a minimum thickness of 3/8" and shall have rounded edges.
  - o. Expansion joint thermal movements:
    - o1. The expansion joints shall be designed for movements and stable operation for the specified design parameters indicated in Section 441130. The CONTRACTOR shall assure that the movements at excursion conditions are accommodated in the joint design without a failure or deformation of the joint.
    - o2. It is the CONTRACTOR's responsibility to design and furnish expansion joints suitable for all specified thermal and non-thermal movements acting simultaneously, plus 25% minimum design margin for movement at any side based on movement given at the center of the liner. Any variation in this requirement shall clearly be stated on the CONTRACTOR's drawings. Expansion joint frames shall not touch under any operating or excursion condition. Expansion joints shall not bind or limit thermal expansion or contraction movements under any of the specified operating or excursion conditions.
    - o3. Expansion joints shall be designed to accommodate the calculated axial, transverse and radial movements without the use of special anchors. It is intended that no spare parts will be required.
- 204.2 Material:
- a. Expansion joint belt shall consist of fluoro-elastomer and aramid fabric reinforcing in accordance with the following specification:
    - a1. The fluoro-elastomer shall be terpolymer with "C" cure [Bisphenol, MgO] using industry recognized methods and Equipment for mixing and quality control/assurance. This includes conformance to the applicable requirements of FSA-DSJ-401-02. Terpolymer percentage must be between 68-75% by weight of compound and must be 100% virgin elastomer [no reprocessed, reclaimed, or blended fluoro-elastomer shall be permitted]. All other additives and curatives must be functional to enhance

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- the physical properties or processing of the fluoro-elastomer. Calendering and press curing is required. Vacuum bag curing is not acceptable.
- a2. The aramid reinforcing fabric material shall be a blend of 55% fiberglass core, 40% Kevlar, and 5% Nomex. The fabric shall have a weight of 32 oz. per square yard and a nominal thickness of 0.060 inches. The fabric shall be prime coated with fluoro-elastomer cement to ensure a minimum adhesion strength between it and the calendered fluoro-elastomer of 20 pounds per inch of width. The use of asbestos or any other reinforcing materials is not acceptable.
  - a3. All delivered products shall be 100% asbestos free and so labeled.
  - b. Field sewing or splicing of the fabric is to be avoided. DISTRICT approval required if field sewing or splicing cannot be avoided due to size of expansion joint.
  - c. Expansion joint frames shall be fabricated from the same material as the ductwork. The backup bars shall be ASTM B575 alloy steel plate and bolted connections shall be fabricated from ASTM B 574 alloy steel rod.
- 204.3 Expansion Joint Construction:
- a. The minimum belt thickness shall be 1/4 inch.
  - b. The expansion joint belt construction shall consist of the following five plies beginning with the gas ply, which is the innermost ply of the expansion joint and as illustrated in Figure 1:
    - b1. Gas Ply: 0.070-inch thick calendered fluoro-elastomer as described in Article 204.2.a1 of this Section.
    - b2. Second Ply: Aramid fabric as described in Article 204.2.a2 of this Section.
    - b3. Third Ply: 0.030-inch thick calendered fluoro-elastomer as described in Article 204.2.a1 of this Section.
    - b4. Fourth Ply: Aramid fabric as described in Article 204.2.a2 of this Section.
    - b5. Fifth Ply: 0.035-inch thick calendered fluoroelastomer as [outer ply] described in Article 204.2.a1 of this Section.



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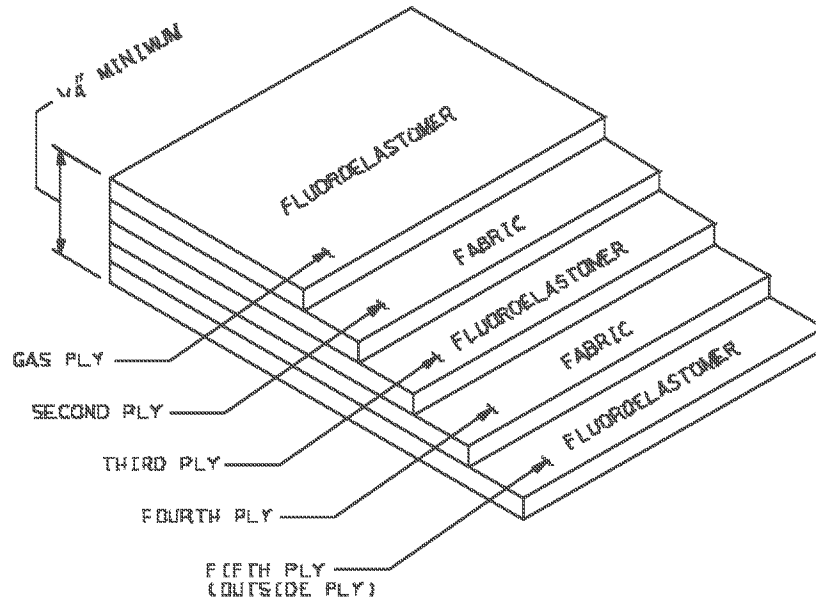


FIGURE 1

- c. Each belt shall be a continuous reinforced belt with no joints or splices which place any stitching or bonding in tension.
- d. The finished product shall be cured or bonded together using a flat bed press. Hand lay-up [bag curing] or "rotocure" is not acceptable. The outermost ply of the expansion joint shall be clearly marked with its identification numbers using a weatherproof marking system.

204.4 Acceptable manufacturers include the following:

- a. Bachmann Industries, Inc.
- b. Pathway, Inc.
- c. Papco Industries
- d. Senior Flexonics
- e. Frenzelit North America, Inc.
- f. Others as accepted by the DISTRICT

204.5 Fabrication:

- a. Expansion joint fabrication shall conform to the requirements specified by the manufacturer, indicated on the expansion joint manufacturer Drawings and specified herein.

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- b. Expansion joints shall be completely shop assembled, tested and shipped to the Project Site as one unit except when the sizes exceed legal shipping limits. If expansion joints are too large for shipment, the frames shall be broken down into largest allowable shipping sizes and match-marked for shipment. The belt shall be fully assembled in the shop. Field sewing or splicing of the fabric is to be avoided. The DISTRICT's approval is required if field sewing or splicing cannot be avoided due to the size of the expansion joint. The belt shall be tightly rolled up for shipment. Backing bars shall be match-marked for field assembly. Backing bars shall be mated to the respective joints to verify hole alignment.
- c. Rigidizing or tie bars may be utilized to maintain the specified face-to-face dimensions until installation is complete. Rigidizing or tie bars shall be identified for removal after installation. Material shall match the frame material.
- d. For protection of the belt during shipment, erection and any welding, a protective metal sheet or foil covering, or equal, shall be provided. This covering will be removed prior to startup.
- e. To prevent damage to the expansion joint belt material due to heat conduction from the studs and backup bars during any stitch welding, insulating tape, washers, bushings or equal means for temperature isolation and protection shall be provided.
- f. To ensure that the expansion joints are installed in the correct configuration clearly mark the gas flow direction on the protective metal sheet or foil.
- g. The expansion joint baffles, if required, shall be minimum ¼ inch thickness and shall be able to withstand the design environment.
- h. Preparation for shipment and delivery: Belts shall be tightly rolled up for shipment. Backing bars shall be match-marked for field assembly. Backing bars shall be mated to the respective joints to verify hole alignment. Expansion joint belt shall be shipped to the Site in an individual crate.

204.6 Installation of Expansion Joints:

- a. The expansion joint manufacturer shall provide the CONTRACTOR with complete detailed instructions on the assembly and installation of the expansion joints.
- b. Tools: Any special tools or equipment required to adjust, dismantle or reassemble the expansion joints shall be furnished by expansion joint manufacturer and/or the CONTRACTOR. Tools shall be forged steel, new and of first-class quality. Tools shall be neatly arranged in a box and shall be shipped to the job in a suitable, separate container clearly marked with the name of the Equipment for which the tools are intended. These tools shall be turned over to the DISTRICT at the completion of the Work.

204.7 Warranty: CONTRACTOR shall fully warrant all expansion joints for a minimum of five (5) years beginning from system startup.

205. CONDENSATE COLLECTION DEVICES

- a. Condensate collection and drainage devices located in the absorber outlet and absorber outlet transition ductwork shall be indicated on CONTRACTOR's design, shop and erection drawings.

206. OTHER MATERIAL

206.1 Filler material such as shims and spacers as required for permanent bolted duct connections to structures and components shall match the adjacent material.

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- 206.2 Rods, Clevises, Turnbuckles, Pins: ASTM A 181, Class 70, unless otherwise indicated. All clevis and turnbuckles shall be reverse threaded and shall be provided with standard nuts and jam nuts to lock the adjusted position.
- 206.3 Welding: Conform to the requirements of Section 050525 and herein.
- a. For welding ASTM A 242 and A588 corrosion resistant steel (formerly Cor-Ten):
    - a1. For shielded metal arc welding use E8018-B2 electrodes per AWS A5.5.
    - a2. For submerged arc welding use F7X-EXXX electrodes per AWS A5.23.
    - a3. For welding ASTM A 335, Grade P11 base metal: The CONTRACTOR shall select the appropriate welding electrode to be used in the process and submit to the DISTRICT for review and acceptance.
    - a4. Electrodes for welding of solid stainless steel shall be as follows:
      - a4.1 For Types 302, 304 and 305: E308 or ER308 for welds in base metal of similar composition, and E309 or ER309 for welding stainless steel to carbon steel, where temperatures are below 700o F. Above 700o F use nickel based filler, F-43 or equivalent, e.g., INCO-A, etc.
      - a4.2 Refer to AWS A5.4 for shielded metal arc welding and AWS A5.9 for submerged arc welding.
      - a4.3 For Types 316L, 317LMN and AL6XN: INCO 112 wire (0.035 inch diameter) or Inconel 625 coated electrode (3/32 inch diameter) or ERNiCrMo4 for AL-6XN; ERNiCrMo3 for 317LMN.
      - a5. Electrode for welding of Hastelloy C-276 clad plate: Inconel INCO-WELD filler metal 686CPT.
      - a6. For welding solid Hastelloy C-276 alloy: ENiCrMo-4 Covered Welding Electrodes (AWS A5.11) or ERNiCrMo-4 Bare Welding Rod (ANS A5.14) or ERNiCrMo-14.
- 206.4 Bolting: Conform to the requirements of Section 050523.
- a. High Strength bolts: Conform to Section 050523.
  - b. Erection bolts: ASTM A307.

### **PART 3 - EXECUTION**

301. GENERAL
- 301.1 Fabrication shall be in accordance with AISC Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design, AISC Code of Standard Practice for Steel Buildings and Bridges other referenced publications and standards as specified in the Contract.
- 301.2 Member Identification:
- a. Properly mark and match-mark materials for field assembly.
  - b. CONTRACTOR shall provide member identification that can be maintained prior and during the field erection process.
  - c. Member identification shall be provided with permanent raised letter marking.

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- d. Member identification shall be unique. Member identification shall be the same as that indicated on the CONTRACTOR's shop detail and erection drawings.
- e. Member identification must use the English language and English system of measurement. Member identification shall be clearly visible and readable.
- f. Wall assembled sections shall be marked with an arrow pointing up to indicate proper orientation. Wall sections of ducts shall have the word "TOP" marked on both faces of the plate near the top edge of plate.

### 302. SHOP DETAIL AND ERECTION DRAWINGS

- 302.1 The CONTRACTOR shall prepare shop detail and erection drawings in accordance with the provisions of the AISC Code of Standard Practice. The drawings shall show in detail the sizes of each component, types and grades of material, connections, welding details, method of assembly, hardware and its connection with other work, and identify areas to be painted.
- 302.2 The shop and erection drawings shall identify the complete penetration groove welds that require 100% radiographic or ultrasonic examination.
- 302.3 The shop drawings shall include, but not be limited to, the following items:
  - a. Complete details including profiles, sizes, locations of ductwork materials, holes, camber, openings, attachments, fasteners and other pertinent data.
  - b. Connection configuration details.
  - c. Bills of material for fabrication and assembly of components including but not limited to size, quantity, material type and weight.
  - d. Indicate shop and field welding with standard AWS welding symbols. Show size, length and type of each weld.
  - e. CONTRACTOR shall verify final duct edge dimensions on the drawings against the final expansion joint face-to-face dimensions.

### 303. FABRICATION

- 303.1 Steel ductwork shall be of all-welded construction
- 303.2 Throughout the entire Work, there shall be as few joints as possible. The general detailing and construction shall be such that the duct will be gas tight. Continuous gas tight weld shall be provided at all interior joints of steel ductwork.
- 303.3 Fabricate ductwork in complete sections and to the greatest extent possible within shipping limitations to facilitate field fabrication of the fewest number of individual pieces.
- 303.4 Drilling patterns for the expansion joint frames shall be identical on both sides of the joint.
- 303.5 The angle or channel frames for connecting steel ductwork to expansion joints shall be shipped loose for welding onto the duct ends in the field.
- 303.6 Requirements for round steel ductwork splices :

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- a. Axial plate splices (longitudinal seam welds) in round duct modules shall be offset by approximately 1'-0", as a minimum, from adjacent round duct modules.
  - b. Round duct stiffener splices shall be offset from axial plate splices by approximately 1'-0", as a minimum.
- 303.7 Bolting shall conform to the requirements of Section 050523.
- 303.8 Furnish all temporary bracing, shoring, etc., necessary to make the ductwork sections structurally stable and free of warpage during shipping and handling. Design of temporary bracing, shoring, etc., shall be by the CONTRACTOR. Mark such members as "TEMPORARY" for removal after erection.
- 303.9 All seams of steel ductwork shall be continuously welded on the inside of the duct so as to provide for airtightness as well as structural strength. Internal duct welds shall be arranged such that all welds can be visually inspected from inside the ductwork to assure that there will be no leakage and also that acid condensate cannot collect between steel faying surfaces.
- 303.10 Fabrication and erection tolerances shall be in accordance with the following:
- a. The CONTRACTOR shall provide a means of compensating for fabrication and erection tolerances in the field.
  - b. Erection Tolerance: The Erection Tolerances as listed in the AISC Code of Standard Practice shall apply unless otherwise specified herein.
  - c. The proper location of support points and squareness of the duct connecting flanges at equipment connections and expansion joints is of the utmost importance in assuring the ductwork will fit properly and have the calculated thermal movements. Therefore the assembled duct and the erected ducts shall have the following tolerances:
    - c1. Support point center lines shall be within + 1/8 inch of the horizontal cold position or + 1/16 inch per 10 feet (1/4 inch maximum) of design distance from the anchor point, whichever is greater.
    - c2. Opposite sides of any flange shall be parallel within + 1/4 inch maximum where expansion joints or dampers are bolted to flanges. Bolt hole center lines in the opposite flanges shall be parallel within + 1/4 inch, and the installed distance between bolt hole center lines shall be within + 1/4 inch of the design dimensions at all points.
    - c3. The opposing faces of two ductwork connecting flanges for expansion joints, dampers, etc. shall not deviate from the true parallel by more than 1/500 in any direction.
    - c4. Two ductwork connecting flanges shall have no more than + 1/16 inch offset across the connecting flanges at the center line of any vertical or horizontal side. In cases where the joint has a design offset, the tolerance shall be in addition to the specified offset.
    - c5. In no case shall the installed flange-to-flange dimension be more than the design flange-to-flange dimension for expansion joints when measured across the centerline of the horizontal and vertical sides. In no case shall the installed flange-to-flange dimensions be more than 1/2 inch different than the design flange-to-flange dimension for expansion joints when measured at any point across the flanges.
    - c6. Flange faces shall be flat within 0.5 degree.

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- c7. The vertical stiffeners at duct support points shall not deviate from plumb for more than 1/500 of duct height in both directions.
- c8. Offsets between duct plates at splices shall not exceed 33% of the thickness of the thinner plate.
- d. Sliding Bearing Plate Tolerance: The installed portion of the bottom plate of the extended ductwork stiffener and the top surface of the lubricated sliding surface shall be parallel within 0.5 degree, not to exceed 1/32 inch over the width or length of the bearing contract area.
- e. These requirements shall be fully considered in fabrication, and CONTRACTOR's shop erection drawings shall be clearly marked with these restrictions.
- f. Round ducts shall have the following additional tolerances:
  - f1. The maximum out of roundness for any location around the duct's circumference shall be 1%.
  - f2. Local distortions from fabrication shall be minimized with the total amplitude of any localized distortions not exceeding 1".
  - f3. The maximum out of roundness at end frames for expansion joint interfaces shall be ½%.
  - f4. Joints forming the seams for the round duct tubes shall be made flush, with no overlap.
- 303.11 Fabricate, assemble and weld built-up sections by methods that will produce true alignment of each principal axis without warp.
- 303.12 Additional Requirements for Hastelloy C276 Ductwork:
  - a. Fabrication of ductwork made from Hastelloy C276 or Hastelloy clad carbon steel shall be per the general ductwork fabrication/erection requirements of this section plus the specific references to Hastelloy throughout this section and the following.
  - b. Hastelloy C276 (ASTM B575, UNSN10276) duct plate, stiffeners, corner angles, etc. shall be provided as shown on the Design Drawings. Hastelloy C276 items shall be specified as solid Hastelloy C276 (for duct plate, built-up stiffeners, bent plate corner angles, etc.) a thin Hastelloy C276 plate clad to a carbon steel (A36) backing plate (for duct plate only), or a thin Hastelloy C276 plate for field attachment to a carbon steel (A36) backing plate.
  - c. Fabrication of C276 alloy duct or built-up members (welder qualification, welding processes, welding qualification, weld joint design, preparation of weld joints, preheat, interpass temperature, post-weld heat treatment, inspection) shall follow:
    - c1. Fabrication Guideline of Haynes International, Document H-2010.
    - c2. Hastelloy C276 Alloy Welding Data, Document H-2031.
    - c3. NIDI (Nickel Development Institute) Reference Book 11012, "Guidelines for the Welded Fabrication of Nickel Alloys for Corrosion-Resistant Service", 1994.
    - c4. NIDI Technical Series No. 14018, Guidelines for Welding Dissimilar Metals.
  - d. Welding of Hastelloy C276 shall also conform to the requirements herein and of Section 050525 of this Specification.

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**FLUE GAS DESULFURIZATION SYSTEMS**



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304. CLEANING AND COATING WORK

304.1 Finish coating of carbon steel surfaces shall be in accordance with the requirements of Section 099113 and to the following:

- a. Uninsulated exterior surfaces of the carbon steel flue gas ductwork and ductwork appurtenances shall be cleaned and coated.
- b. Corrosion Protection: All machined surfaces and other bright parts shall be coated with a suitable antirust compound that can be easily and completely removed prior to erection, or which has characteristics that make removal unnecessary prior to erection.

END OF SECTION 051800

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